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ABSTRACT

A more comprehensive definition of the variable "interaction" is needed to answer the numerous questions concerning interaction effects in distance learning. This study attempts to qualify the concept of interaction by applying various dimensions such as amount, timeliness, method, spontaneity, and quality. In turn, these dimensions of interaction lend themselves to the creation of a taxonomy for research and evaluation purposes. Background information on instruction, communication, and interaction is provided. The relationship of interaction to other instructional variables, such as instructional strategy and course variables, is outlined. The paper concludes by recommending further research to enhance the interaction taxonomy and the overall body of knowledge relating to distance learning. (Contains 34 references.) (MAS)

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A STUDY OF INTERACTION IN DISTANCE LEARNING

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To answer the numerous questions concerning interaction in distance learning, a better definition of the variable interaction is needed. This study attempts to qualify the concept of interaction by applying various dimensions such as AMOUNT, TIMELINESS, METHOD, SPONTANEITY, and QUALITY. In turn, these dimensions of interaction lend themselves to the creatrion of a taxonomy for research and evaluation purposes.

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PREFACE

This technical paper addresses interaction in distance learning and lays out a taxonomy of interaction for evaluation and research. The taxonomy provides a framework which attempts to provide a more comprehensive definition of the variable interaction, and will serve to answer many questions about interaction effects in distance learning. The paper concludes by recommending further research to enhance the interaction taxonomy and the overall body of knowledge relating to distance learning.

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SUMMARY

Many distance learning questions remain unanswered, particularly in the areas of student-instructor, student-student, and student-material interaction. At present, interaction has been insufficiently defined for research purposes; a survey of the literature validates this point by showing that most studies were lacking in rigor and the methodologies were weak with regard to interaction.

Increased participation and ensuring valuable interactivity are key elements of a successful distance learning program. This paper removes an obstacle to meaningful research by creating a taxonomy which more completely defines interaction in terms of amount, type, timeliness, method, spontaneity, and quality. Accordingly, researchers will be able to utilize this information to more effectively determine the best and most cost effective techniques for eliciting interaction.

A STUDY OF INTERACTION IN DISTANCE LEARNING

I. INTRODUCTION

In the past distance learning has been largely used to bring education and training programs to learners who would otherwise not have access to the classes offered (*U.S. Office of Technology Assessment, 1989).* Courses and programs have been offered primarily for adult learners interested in college credit or vocational and professional improvement. Distance learning networks are operated for the most part by colleges and universities or by corporations and government agencies.

There is ample evidence in the literature that, in most cases, distance learning appears to be as effective as face-to-face instruction in the classroom (Moore, 1989). A comprehensive review of the current research regarding the use of dynamic video media in instruction conducted by Wetzel, et al. (1994) found, "The general conclusion from this evolving field is that it is possible to have no decrement or only a small decrement at a remote site compared to the performance of students at the live transmitting site" (p. 20). They examined studies of both preproduced telecourses (i.e., non-interactive) and interactive teletraining in terms of effectiveness, acceptance and costs. They found the primary attraction of distance learning for students is convenience: proximity to where they work and live and flexibility in personal scheduling and work requirements.

In a comprehensive review of the current research regarding the use of dynamic video, the Texas Higher Education Coordinating Board (1986) reviewed the course results of four college level telecourses and found student achievement was comparable to conventional on-campus classes. They also examined grade distributions of Texas community colleges offering telecourses and found they did not differ significantly from traditional classroom grade spreads. A review of the literature by Miller et al. (1993) could not identify a single study that has shown distance learning diminished content learning. Some studies found advantages of distance classes over traditional classroom instruction (e.g., Barron, 1987; Weingard, 1984; Keane & Cary, 1990).

Most distant learners report they are satisfied with their remote instruction and some reportedly preferred the distance learning mode. However, the limited number of studies in the affective domain and the lack of rigor in the methodologies do not permit reliable conclusions about preference.

That these effects hold true for many subjects and a variety of media and delivery means, indicates that learner motivation may be an overarching factor in the learning process *for these students.* Indeed, it has been asserted that motivation is the single most important factor for student learning and when motivation is high, it is difficult to prevent learning (Main, 1992).

However, distance learning is entering a new phase. The transformation from analog to digital communication technology is creating a new environment for multimedia interactive instructional media and telecommunication networks. Distance learning is no longer being viewed as simply a means to provide access for those unable to meet in the classroom, but as a viable alternative to classroom instruction as a primary mode of instruction . The promise of two-way interactive video, voice and data available in every home and office via the information superhighway has fired the imagination of educators and non-educators alike in the potential for providing elementary and secondary schooling in classrooms without walls. Decisions are now being addressed on the basis of how cost-effective distance education is compared with traditional classroom instruction. The sentiment is reflected in a recent comment by a corporate officer that the "lean budgets of today's economy drive alternative training and educational delivery systems. Traditional stand-up instruction does not stand up to the scrutiny of the cost conscious business manager" (Grant, 1994). Universities are experimenting with delivery of instruction to students in their dormitory rooms or homes through local area networks or public data services such as America Online. Public telephone and cable distribution systems are under study as well, as a means of providing instruction without assembling students in a classroom.

Whether the success of distance learning with adult learners will work equally well for all students is still a question. Most applications to date have been involved with academically advanced high school students and independent adult learners--individuals who presumably already possess strong study skills, high motivation and discipline (*U.S. Office of Technology Assessment, 1989).* The Congressional Office of Technical Assessment (OTA) has concluded that research of distance learning for elementary and secondary application would be most usefully concentrated on practical questions about the educational experience such as learner outcomes of various teaching techniques and instructional design approaches.

With distance learning being considered as a replacement for traditional classroom, the designers and developers of distance learning instruction can no longer depend upon the intrinsic motivation of self-selection. Like the public school teacher in the traditional

classroom, the students will present an array of interest in the subject and education for the distance learning instructor. The changing nature of the distant learner from adult volunteer to adolescent required attendee presents new requirements for the instructional designer and teacher.

This study examines interactivity as a function of the instructional design and presentation of distance learning lessons. The complex interplay of interaction in distance learning is not well understood at this time (Haynes & Diehorn, 1992). One reason is the relative dearth of studies examining interaction in distance learning education. Others include the poor controls used in the research that has been conducted and a reliance on self-selected groups exposed to the distant learning and traditional classroom conditions. Finally, there is the relatively simplistic manner in which interaction has been defined in the studies. It is also likely that studies showing poor performance for distance learning situations are less likely to be submitted for publication or published when they are submitted.

II. BACKGROUND

Intuitively we know that interaction is important in the instructional process. We strive for interaction in the traditional classroom. The concept of small teacher-student ratios is based on the belief that the smaller class size permits a richer interaction. The ultimate learning environment is considered to be one-on-one where the instruction can be individualized to the student's perceived needs and learning style. It is axiomatic that proximity in interpersonal communication enriches interaction. Wetzel et al. (1994) determined that, "Increasing the degree of fidelity or interactivity of video teletraining to that with live instruction generally increases effectiveness and satisfaction "(p. 21). But the empirical evidence is weak and the studies cited are generally lacking in methodological rigor. Klinger and Connet (1992) state, "...telecourses must include a strong element of interaction to be truly effective as a learning method. Interaction is *essential* for the student to remain interested and steered forward for success" (p. 88). Their conclusions, however, are based on experience rather than empirical studies. How, then, are we to explain the results of the many studies which indicate there is little difference in learning between students in the traditional classroom and students at distant learning sites?

It is difficult to tell from the literature. There are very few studies that have examined interactivity as an independent variable and those that purport to have studied its effects generally looked at interaction only in terms of frequency. For example, Van Haalen and

Miller (1994) reported on interactivity as a predictor of student success in a satellite learning program, but interactivity was measured on the basis of telephone logs recording only the number of calls from students to the teacher both during and after class for the school year. No attempt was made to capture the length of the interaction or its topical relevance. Most interaction reports are observational and associated more with learner attitudes about the delivery mode than with achievement. Rupinski (1991), for example, found that student preferences for traditional classroom training can be reduced by making conditions at the remote site (including two-way video) more like a "live" classroom.

From studies where interaction is included as a variable, the effects of interaction of learning outcomes is ambiguous. In a study comparing instruction by audiotape, videotape and telelecture, Beare (1989) found the lack of individual opportunity to interact with the instructor regularly did not significantly reduce student scores on course examinations. In a one-way video course with two-way audio, Van Haalen and Miller (1994) reported interaction effects were not linear but, rather, a polynomial curve in the form of an inverted U. At each end of the interactive continuum, student performance (in terms of course grades) was poor. They only measured student initiated interactions with the instructor, however, and not interactions designed into the instructor's presentation as student-student discussion activities. It is possible that in this situation, the students with the most questions are those with a need for additional information to keep up with the instruction. Conversely, students who never ask questions may be reluctant to expose a lack of knowledge.

A problem with the descriptive studies is the lack of a control group. How do the students in the distant learning class differ from those in the residential classroom? Zigerell (1986) gives a hint with his survey of telecourse students in community college courses. Most of the students had not taken a telecourse before (65 percent). Of those, 69 percent were women, and carried less than 10 semester units. About half worked at least 40 hours a week. Only 17 percent said they were enrolled because they preferred distance learning. This is quite different from most residential college students.

In one of the more carefully designed comparative studies, (Simpson et al. 1991) found the most critical condition for success in interactive teletraining is the ability of students to see the instructor and have two-way audio communication . Two-way video appeared to have little effect, but any degradation in audio quality caused negative comments. Not surprising since most instruction is still language-based. In comparing final examination scores, the

decrease between student performance at the originating site and the remote sites was less than 3 percent in any of the instructional modes. The value of Simpson's studies are that they compared complete courses--not just modules covering a few hours of instruction. Stoloff (1991) found distant learners became more indifferent to differences between teletraining and traditional classroom methods of instruction over time, but instructors still favored their classroom.

There is a need in distance learning research to adopt an expanded view of effective teacher-student communication. It involves integrating a variety of communication forms and channels that include verbal communication, vocal communication--the volume, rate, tone, pitch and inflection--mediated messages, body language and situational messages--manipulation of distance, time and number of participants (Hennings, 1975).

III. INSTRUCTION, COMMUNICATION AND INTERACTION

Teaching is primarily a communication art. If we accept the interdependent relationship between source and receiver in the communication process described by Berlo (1960), then teaching should emphasize interaction between instructor and learners. We learn by taking an active role in the process (Hefzallah, 1990). Buckminster Fuller asserts the instructional environment "is an interacting situation in which the continuity of experience and the relating of experience are critically important." (1966, p 16). Hefzallah summarized the connection succinctly, "to teach is to communicate, to communicate is to interact, to interact is to learn (1990, p 38)."

Socrates knew the value of interaction in learning. Students were required to discover knowledge through a series of questions and answers. By contrast, the Sophists were the first lecturers. They knew everything and were ready to explain it (Highet, 1957). But, here's the rub. While the Sophists grew rich, dressed in royal purple and traveled by sedan chair, Socrates' sandals were worn and his tunic undyed. His discovery learning was not cost-effective. To make intelligent decisions in designing distance learning systems and lessons, we need information about the trade-offs between effectiveness and efficiency in the amount and quality of interaction in the instructional process.

The seminal studies by Chu and Schramm (1979) established that children learn efficiently from instructional television and from instructional radio "given favorable conditions" (p.# vi and 1). The favorable conditions generally refer to the similarities in presentation where

students in both groups hear the same lecture, see the same visual and read the same printed materials. Most of the studies supportive of these conclusions contrasted students in traditional classes with those at remote locations. For the most part, the studies reviewed by Chu and Schramm used a mass media model for the instruction, i.e., the transmission was largely one-way with feedback limited and delayed. In this mode, the student is largely passive, at least in terms of real-time interpersonal interaction. This is the conduit theory of communication applied to distance learning described by Clark (1983) as an analogy in which "media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p. 445). To extend Clark's analogy, however, if the truck can't be refrigerated to carry fresh fruit, that does affect our nutrition. So, the capability of the delivery system is a factor in the instruction presentation and possibly student learning.

In his review of the distance learning literature, Kozma (1991) acknowledged the mass media conduit theory, but concluded the interpersonal theory of communication with its rich and immediate feedback was more appropriate for the interactive nature of teaching. Distance learning should attempt to replicate the "live" classroom through "virtual medium" (Kozma, 1992, p. 182).

It's not only the quantity of interaction that affects the learning . The quality of interaction is also a factor. The interminable prompt to press ENTER that was so common in early computer aided instruction although interactive was a numbing experience. Dale states "education has to choose creative interaction of the learners over rote imitative reaction" (1978, p. 24). This is what designers of distance learning education face: determining the amount and nature of interaction that is most effective and efficient for achieving the learning objectives of the class.

Two issues are identified by Miller et al. (1993) as being important in considering how well distance learning duplicates the learning environment of the traditional classroom. The first is whether interaction is reduced among distance learners. Even though the technical capacity for such interaction is available, students may be inhibited from participating interactively by a variety of reasons such as awkwardness in interrupting or unfamiliarity with equipment. The second issue concerns the degree of student engagement in traditional and distance learning conditions, i.e., do distant students tend to be less attentive in a distance learning environment? Nadel (1988) in a comparative study of distance learning modes concluded that students learn from any medium, in school or out, whether they intend to or

not, providing the content of the medium leads them to *pay attention* (emphasis added). That is a very large proviso and corresponds to Kozma's (1991) concept of involvement which is manifested behaviorally as participation and can be measured by interactions.

IV. A TAXONOMY OF INTERACTION FOR EVALUATION AND RESEARCH

To answer the many questions about interaction effects in distance learning, a better definition of the variable interaction is needed. Interaction in distance learning is obviously a complex behavior. What is needed is a model for examining its many dimensions. Boak and Kirby (1989) developed the System for Audio Teleconferencing Analysis (SATA) instrument for analyzing classroom interaction that affords some direction for researchers. Their schema has three categories: who initiates the interaction (student or instructor); the direction of the interaction (an individual student, the class as a whole, or instructor); and the context of the interaction (procedural, content specific, or social).

This schema can be expanded to examine more thoroughly the interaction process in the distant learning classroom. Six categories of interactivity have been identified by this researcher as relevant for distance learning research. These may not be comprehensive but provide a beginning point in developing a taxonomy of distance learning classroom interaction. They are **AMOUNT, TYPE, TIMELINESS, METHOD, SPONTANEITY**, and **QUALITY**. Each of these components are compound variables themselves with several levels.

1. There are two dimensions in measuring the **amount** of interaction--the frequency of occurrence and the length of the dialog. Frequency is perhaps the most commonly captured data in distance learning studies involving interaction. It is most often examined in terms of how often student feedback occurs, i.e., the mean occurrence per student per class period. Frequency can also be measured by how it is spaced during the presentation (clustering by instructional activity.) The length of each interaction is relatively straight forward and is of greatest interest when related to **type, method** and **quality.**

2. The **type** of interaction refers to the participants. In a distance learning class this would include instructor-student exchanges, student-student interactions, and student involvement with the lesson materials. The instructor-student interaction can be further categorized as to whether it is instructor initiated or student initiated. Student-lesson materials interaction may be either required or student choice. Each of these levels can be further

subdivided as occurring within the class period or outside the class period. The measurement would be frequency of occurrence. The cells would appear as follows:

Initiated by Instructor Student	Student- Student	Student-lesson Materials Required Voluntary		
				Within Class
				Outside Class

Figure 1. Types of Interaction

Measuring student-to-student interaction will require some means for observing or recording activity at the distant learning site(s). Haynes and Dillon (1992) found distance students in a library science course interacted much less with the instructor and much more with each other during class even though they complained at times that it interfered with attending to the instructor. The results of the study did not indicate a significant difference in student performance between exam scores of distant and on-site learners which would seem to show interaction type has little effect on distance learning. There are some methodological problems with the study, however, that make generalization of the findings difficult.

3. **Timeliness** is a measurement of the immediacy of the communication feedback. It is the amount of time between the attempt to interact begins until the message is received by the addressee. It is an indicator of the efficiency of the communication system. It presumes a two-way communication system. In those situations where the instruction is preproduced and delivered on schedule or on demand, there is no interaction in the class. Broadcast television and cable delivered instruction fall into this category. It's the mass media model of communication. An example might be Ken Burns' *Civil War* television series aired over PBS. It was certainly educational, but a passive one-way delivery when viewed on PBS. However, when video tapes of that series are used by a teacher as instructional material in a distance learning history class where feedback is expected of students discussing the programs, the instruction becomes interactive. **Timeliness** is a continuous variable that ranges from zero in

the real-time interactions of a traditional classroom to several days or even weeks for a correspondence course administered through the post office.

4. The **method** of interaction refers to the manner in which the communication message is encoded. Voice is the most common method of interaction in the traditional classroom. Satellite transmissions of one-way video with a two-way telephone audio channel have been the system of choice for most distance education and training systems. However, there has been considerable interest in text-based interaction systems using computer-based data network delivery. With the conversion of analog to digital communication and the interest in establishing high capacity public switched digital infrastructure, there is an expanding effort to determine how this information superhighway can be exploited for education and training use. Already, compression technologies allow two-way, real-time digital video and audio transmission over conventional twisted pair phone lines through digital switches albeit without full motion or the fidelity of analog television. The **method** of interaction, then, should be addressed in studies of interaction effects. In addition to voice and text, interaction may occur through visual non-verbal gestures, response pads, graphic display, and photos. There are obviously many combinations and sub-levels possible with the various methods that need to be considered in developing the measurement methodology and instrument especially when newer multimedia workstations are used in the delivery of instruction.

5. The **spontaneity** dimension of interaction refers to whether the feedback is a planned event embedded in the lesson plan as part of a learning activity or a spur of the moment exchange triggered by the presentation. It may be important to determine whether *ad hoc* interactions are one-on-one or part of a group discussion. **Spontaneity** can be cross-tabbed with **amount, type** and other variables of the interaction schema.

6. The **quality** of interaction is the most difficult dimension of interaction to define operationally. The possible levels are almost infinite. Many of the other categories have quality implications and a case could be made that this is an overarching variable that subsumes all the components of interaction. For purposes of this taxonomy, **quality** is defined in five dimensions: *intensity, relevance, depth, formality*, and *opportunity*. *Intensity* reflects the emotional involvement of the participants in the interaction. The levels are routine (which includes repetitive, procedural and expected responses); interested (exploratory, explanatory, and expansive), and emotionally involved (excitement, fear, enjoyment, attachment, and anger).

It is difficult to distinguish the intensity of a communication exchange, but trained observers can discriminate among the categories.

The components of *relevance* are classified as professionally related, involve the lesson content (subject matter) or have personal relevance. *Depth* is a continuum ranging from the trivial to substantive. The *formality* of the interaction is classified as formal or informal. *Opportunity* is the ability to interact when desired. It could be a function of class size, the technical capability of the system, or the instructional design of the lesson that accommodates interactions. Real-time two-way audio and video is expensive and the cost increases in direct relation to the number of distant learning sites. It is important in emulating a traditional classroom, but the value decreases as the number of students in the class increases. The *opportunity* for interaction is inversely correlated with the class enrollment. The effect of class size is as true for the student in the traditional classroom as it is for the distant learner. Everyone remembers those large lecture halls where a professor addresses a class of hundreds. A satellite broadcast may enlarge the class to thousands of students. The chance of interacting with the instructor dwindles no matter how sophisticated the communication system. While the concept of the President appearing on a national talk show to interact with the public is politically appealing, the opportunity of any particular citizen to actually ask the president a question (never mind a give and take dialog) approaches the probability of winning the lottery. The idea that the caller who does get to ask a question represents some number of other viewers or listeners may have some validity, but is accomplished more economically by use of studio questioners. It is worthwhile measuring timeliness, however, even when the size of the class makes opportunity difficult. A study by Fulford and Zhang (1993) suggests the perception of overall interaction is a stronger predictor of student satisfaction than personal interaction. Although the class size was only 123 students in five locations, two of which had one-way video and two-way audio and three with two-way video and audio. The perception of overall interaction (self report) and satisfaction with the class had a strong correlation despite the actual number of personal interactions. The strength of "vicarious" interaction effect did diminish from the first of the three sessions to the last. We shouldn't be too surprised by these findings. The appeal of game shows and talk shows is largely the interaction between host and guests or contestant.

This taxonomy of interaction variables provides a framework for research and evaluation of the effects of interaction in distance learning. It may need modification and elaboration as new questions arise, but it allows the research to proceed more systematically in order that findings may be grouped for meta-analysis and meaningful comparisons made among studies.

The next step is to develop operational definitions and measurement instruments for each variable that can be tested for accuracy and validity. The goal is to establish a body of literature from which theoretical concepts and generalizations can be made as to the efficacy of interaction activities that will be useful to system designers and instructional developers of distance learning instruction. The need for better methodology in distance learning studies is apparent. Research to date indicates there is little difference in achievement attributable to delivery technique. Intuitively that does not seem right even though studies have consistently reported performance of standardized tests to be similar, regardless of medium used (Salomon & Clark, 1977; Ritchie & Newby, 1989).

V. RELATING INTERACTION WITH OTHER VARIABLES

Interaction always occurs within a context. The utility of organizing the dimensions of interaction variables lies in finding how they relate to other components of distance learning. There are numerous factors that may be affected by, or have an affect on, interaction in distance learning. Generally these factors can be classified as those concerned with the course and those dealing with its delivery, i.e., the communication technology. The communication technology is continually changing and especially at this watershed stage of conversion from analog to digital communication. Not only are the media becoming amorphous with digital multimedia, but also the industry infrastructure is in a state of flux as telephone, cable, and television companies seek acquisitions, alliances and mergers that will position them as players in the digital, interactive, multimedia future of the information superhighway. New products, new systems and new capabilities will demand continuing research for its effects on distance learning interaction.

Instructional strategies and activities involve all the components of instructional design with the added complexity of distance delivery (Wagner, 1990). There is a large body of literature available on instructional process, but despite the scrutiny of what goes on in the classroom, teaching remains very much an art form. Distance learning may depend even more on instructor charisma and style than the traditional classroom in which case instructor characteristics are important to examine in terms of their effect on interaction. It is axiomatic that the difference between a good teacher and a great teacher is the ability to motivate their students to learn (Main, 1992). Interpersonal communication skills are more critical when students are not physically present in the classroom. The technology of distance learning changes the dynamics of instruction. Beaudoin (1990) suggests distance education revolves

around a learner-centered system with instructor skills focused on facilitating learning and organizing instructional resources.

Inserting technology in the instructional process requires greater attention to lesson design and instructional preparation. This factor needs to be more carefully examined and controlled in distance learning research. Miller (1989) argues that curriculum issues are more important than the delivery technology. Farr and Shaeffer (1993) provide a discussion on media selection variables for distance learning application.

Course variables include such things as the subject matter, student characteristics, instructional strategies and activities, media selection and instructor characteristics. Subject matter can be characterized in terms of type (cognitive, psychomotor, affective), depth or complexity (basic skills, advanced studies), application (practical, theoretical), level of proficiency (familiarity, mastery, automation) and domain (history, language skills, electronics, etc.). This listing is not comprehensive. Each category is a compound variable and the dimensions provided are certainly not exhaustive. There may be other taxonomies of instructional techniques and subjects that may be more useful for hypotheses generation for a particular distance learning situation.

Student characteristics involve age, gender, motivation, prior knowledge and experience. An important consideration is whether enrollment is voluntary or required. Self-selection of distance learners and traditional classroom students contaminates many of the field studies reported in the literature. This may not be an important factor when distance learning is only used as an outreach for students unable or unwilling to attend residence courses. The relevant question is, do the students learn? How does interaction affect the learning for *these students.* It is when distance learning is being considered as an alternative for traditional classroom education and training that attention needs to be given to any differences between the comparison groups. To make generalizations about interaction effects for this use of distance learning, the differences in characteristics of students who select distance learning and those in the traditional class setting must be controlled.

VI. CONCLUSION

The successful expansion of distance learning as an alternative to the traditional classroom is dependent upon the improvement of instructional design to approximate the richness of the interaction that occurs face-to-face. The technology for fully interactive

distance learning is not the hurdle. The problem is how to elicit active participation by the learner whose interest in the particular subject and education, in general, is minimal at best. Interactivity seems to hold promise. We need to find the best techniques for achieving it in a cost effective manner. Hopefully, this taxonomy will serve as a useful tool in finding some answers.

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